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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:)
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Applicants: Nace Layadi, et al)
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Examiner: Mai, Amh D.)
)
Serial No.: 09/905,398)
)
Filed: 7/14/2001)
)
Group Art: 2814)
)
Attny. Docket: Layadi 30-23)

For: POLISH OR ETCH STOP LAYER

Board of Patent Appeals and Interferences
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANT'S BRIEF UNDER 37 CFR 41.10

This brief is in furtherance of the Notice of Appeal filed in this application on July 14, 2004 (with a one-month extension).

1. REAL PARTY IN INTEREST - 37 CFR 41.37(c)(1)(i)
The real party in interest in this Appeal is the assignee of the present application, Agere Systems, Inc., a corporation of the State of Delaware.
2. RELATED APPEALS AND INTERFERENCES - 37 CFR 41.37(c)(1)(ii)
There is no other appeal or interference that will directly affect, or that will be directly affected by, or that will have a bearing on the Board's decision in this Appeal.
3. STATUS OF CLAIMS - 37 CFR 41.37(c)(1)(iii)
Claims cancelled: 6 and 8-17

(Note: two claims were erroneously numbered 16 in the original application. Because of this mistake, no claim 18 was ever presented in the application).

Claims withdrawn but not cancelled: none.

Claims pending: 1-5, 7 and 19-21.

Claims allowed: none.

Claims rejected: 1-5, 7 and 19-21.

The claims on appeal are 1-5, 7 and 21 (Claims 19-20 are not appealed)

4. STATUS OF AMENDMENTS - 37 CFR 1.192(c)(4)

The amendment submitted after the Final Rejection contained in the Office Communication dated 04/14/2004 has been entered and no other amendments are pending.

5. SUMMARY OF CLAIMED SUBJECT MATTER- 37 CFR 41.37(c)(1)(v)

In general, conventional planarizing techniques in the cleaning stage of deposition are inadequate for interconnect systems with more than three layers of metal. However, global planarization of both dielectric and metal layers is possible with Chemical Mechanical Planarization (CMP) (sometimes referred to as "polishing."). Although serving as a valuable planarizing technique and offering a number of advantages, a major disadvantage known as dishing is also associated with CMP. Dishing involves the thinning of regions that are exposed when a film is being planarized down to a CMP-stop layer. Applicants have discovered that TiAlN can be used as a polish/etch stop material when deposited in a layer over a dielectric material and solves this long-felt limitation during such CMP processing, while boosting commercial success.

Claims 1 and 21 are independent claims, each of which recite a semiconductor structure having a TiAlN polish stop layer deposited over a dielectric material in order to protect the dielectric material during the polishing of a metal layer deposited over the TiAlN and dielectric. The metal layer is typically tungsten and is deposited in order to fill vias in the dielectric material. All of the tungsten layer must be removed leaving only the tungsten plugs in the vias. FIG.'s 1 and 2 show the structure before and after

planarization and are described in the specification at page 4, line 24 through page 5, line 20.

6. GROUNDS OF REJECTION TO BE REVIEWED UPON APPEAL -

37 CFR 41.37(c)(1)(vi)

(A) Claims 1-5, 7 and 21 are rejected under 35 USC 103(a) as being unpatentable over Yamashita (JP patent 08-107148) in view of Meikle (U.S. patent 5,231,306).

7. ARGUMENT 37 CFR 41.37(c)(1)(vii)

A) Rejection of claims 1-5, 7 and 21 under 35 USC 103(a) as being unpatentable over Yamashita (JP patent 08-107148) in view of Meikle (U.S. patent 5,231,306).

The Examiner cites Yamashita for the premise that Yamashita teaches a semiconductor device including a polish stop layer, wherein the polish stop layer comprises titanium nitride (TiN). The Examiner further discusses that in view of Meikle, titanium aluminum nitride can be used in place of the TiN layer.

The Examiner, however, admits that Yamashita fails to disclose the claim 1 limitation of “wherein said polish stop layer comprises titanium aluminum nitride.” The Examiner states “Meikle teaches that TiAlN are known in the art to be used in place of TiN in semiconductor devices” and that “it would have been obvious to one having ordinary skill in the art at the time of invention to form the polish stop layer (30) of Yamashita using TiAlN as taught by Meikle because TiAlN material is more resistant to diffusion than TiN.” According to the Examiner, “[b]y the teaching that TiAlN can replace TiN in many of its uses in (underlined by Examiner) semiconductor devices, it is more probabl[e] than not [that] TiAlN is capable of function as a polish stop layer.”

The Examiner incorrectly assumes that a polish stop layer is being used in semiconductor devices. A polish stop layer is not used in semiconductor devices but is rather used in the fabrication of semiconductor devices. According to Meikle, “[TiAlN] can replace TiN in many of its uses *in semiconductor devices*.” Yamashita’s polish stop layer, like that of Applicant’s, is not being utilized “in semiconductor devices.” but is used instead “in the fabrication of semiconductor devices.” For this reason, Meikle’s

statement regarding the possible replacement of TiN with TiAlN is inapplicable to polish stop layers. Therefore, Examiner incorrectly cites Yamashita in view of Meikle.

Furthermore, MPEP 2143.01 provides: The mere fact that references can be combined or modified in hindsight does not render that resultant combination obvious. Rather, the prior art must also suggest the desirability of the combination (In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990)). Meikle provides a diffusion barrier comprising an alloy of titanium, nitrogen, and aluminum. However, Meikle neither teaches nor suggests that TiAlN can be used as a polish stop layer. It is well known that various different materials can be substituted for other materials in some applications but not in others. For example, tungsten serves well as a filament in a light while aluminum quickly is destroyed. Yet both of these are electrical conductors and are used as such in semiconductor structures. The examiner's logic would suggest that aluminum could function as a light filament since it can be used as an electrical conductor.

The Examiner has failed to satisfy the burden of factually supporting the prima facie conclusion of obviousness as set forth in MPEP 2142. For TiAlN to be employed in Meikle's diffusion barrier as well as in Applicant's polish stop layer is simply nonobvious. A diffusion barrier is unlike a polish stop layer. A diffusion barrier is used directly within a semiconductor device to resist molecular diffusion between two interfaces. Diffusion is defined as the movement of one material through another via a natural chemical process. As Meikle describes, a diffusion barrier is used in the semiconductor device to prevent interdiffusion of a metal and silicone interface, which will occur over time even at room temperature. Applicant, on the other hand, teaches the use of TiAlN during the stage of Chemical Mechanical Planarization (CMP) for fabricating a semiconductor device. While Applicant uses TiAlN during the process of fabricating a semiconductor device, Meikle uses TiAlN to ultimately operate within a finished semiconductor device. Meikle, therefore, does not teach, suggest or motivate the use of TiAlN as a polish stop layer.

Prima facie obviousness also requires a reasonable expectation of success. In re Clinton, 188 USPQ 365. Meikle's teaching regarding the performance of TiAlN for preventing interdiffusion of silicon and aluminum at a silicon/aluminum interface provides no basis for any expectation regarding the performance of that material as a

polish stop layer. Furthermore, the fact that Meikle teaches TiAlN is more resistant to diffusion than TiN provides no motivation for using titanium nitride alloyed with aluminum in place of titanium nitride as a polish stop layer.

The Examiner has failed to satisfy the burden of factually supporting the prima facie conclusion of obviousness as required under MPEP 2142. First, the Examiner describes the teaching of Yamashita and states “wherein the barrier layer (27) functions as an etch stop layer. (See Fig. 6).” This is technically incorrect, since layer 27 of Yamashita has clearly been partially etched away during the dielectric-etching step illustrated in FIG.5. Thus, Yamashita actually teaches that the material of layer 27, which is titanium nitride, will not function as an etch stop layer.

Meikle states at column 2, lines 35-36 that “TiAlN etches readily in $\text{NH}_4\text{OH}/\text{H}_2\text{O}_2$ similar to TiN.” Thus Meikle fails to recognize the significantly different etch properties of these two materials. Accordingly, it is not proper to combine Yamashita and Meikle since the substitution of titanium nitride alloyed with aluminum from Meikle into the layer 27 of Yamashita would interfere with the etching step of FIG. 5 of Yamashita wherein a portion of that layer is intentionally removed. Thus, the combination of the teaching of Meikle into the device of Yamashita would not result in the intended structure of FIG. 6 of Yamashita, thereby destroying the intent of the Yamashita patent.

Claim 21 includes the limitations of “a layer of titanium aluminum nitride disposed of the metal layer” and “ wherein the layer of titanium aluminum nitride function as an etch stop layer upon removal of the selected portion of the dielectric layer to prevent the etching process from compromising the underlying metal layer.” The combination of Yamashita and Meikle fails to establish a prima facie case for the obviousness of this claimed combination.

While the ultimate conclusion of obviousness is for the court to decide as a matter of law, several factual inquiries underlie this determination. Graham v. John Deere Co., 383 U.S. 1, 17-18, 15 L. Ed. 2d 545, 86 S. Ct. 684 (1966). These inquiries include the scope and content of the prior art, the level of ordinary skill in the field of the invention, the differences between the claimed invention and the prior art, and any objective evidence of nonobviousness such as a long-felt need and commercial success. Id., Akamai Techs. v. Cable & Wireless Internet Servs., 344 F.3d 1186, 1195-1196 (Fed. Cir.,

2003).

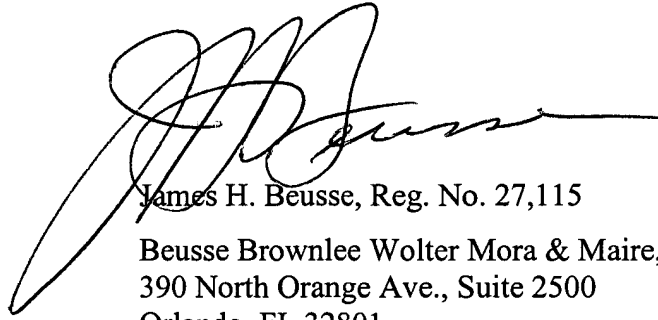
When a rejection depends on a combination of prior art references, there must be some teaching, suggestion, or motivation to combine the references. In re Geiger, 815 F.2d 686, 688 (Fed. Cir. 1987). Although the suggestion to combine references may flow from the nature of the problem, Pro-Mold & Tool Co. v. Great Lakes Plastics, Inc., 75 F.3d 1568, 1573 (Fed. Cir. 1996), the suggestion more often comes from the teachings of the pertinent references, In re Sernaker, 702 F.2d 989, 994 (Fed. Cir. 1983), or from the ordinary knowledge of those skilled in the art that certain references are of special importance in a particular field, Pro-Mold, 75 F.3d at 1573 (citing Ashland Oil, Inc. v. Delta Resins & Refractories, Inc., 776 F.2d 281, 297 n.24 (Fed. Cir. 1985)).

In no patents referred to by the Examiner nor in the ordinary knowledge of those skilled in the art is there any suggestion that using TiAlN as a polish stop layer would be obvious. When determining the patentability of a claimed invention which combines two known elements, "the question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination." In re Beattie, 974 F.2d 1309, 1311-12 (Fed. Cir. 1992) (quoting Lindemann Maschinenfabrik GMBH v. Am. Hoist & Derrick Co., 730 F.2d 1452, 1462 (Fed. Cir. 1984)). An invention will not be rendered obvious merely by combining teachings found in the prior art. There must be some suggestion or incentive in the prior art to make the combination. The prior art must suggest that the combination would have a reasonable likelihood of success. In re Bolduc, 1992 U.S. App. LEXIS 2480 (Fed. Cir., 1992). The Applicant is aware of no prior art that suggests a reasonable likelihood of success associated with the combination of titanium, aluminum and nitride in a polish stop layer. More importantly, the Examiner has not met the proper burden of proving that the referenced prior art sufficiently suggest otherwise. Accordingly, the rejection under 35 USC 103(a) should be withdrawn.

8. APPENDIX OF CLAIMS - 37 CFR 41.37(c)(1)(viii)

An appendix containing a copy of the claims involved in this appeal is provided herewith. No evidence appendix under 37 CFR 41.37(c)(1)(xi) or related proceedings appendix under 37 CFR 41.37(c)(1)(x) is required.

Respectfully submitted,

A large, stylized handwritten signature in black ink, appearing to read 'J. Beusse', is written over the printed name.

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APPENDIX OF CLAIMS ON APPEAL

1. (Amended) A semiconductor structure comprising:
a substrate having a device feature formed thereon;
a dielectric layer disposed over said substrate and device feature and having at least one contact hole formed therein;
a polish stop layer disposed over the dielectric layer and extending within the contact hole;
a layer of metal disposed over the polish stop layer within the contact hole and forming a plug; and
wherein said polish stop layer comprises titanium aluminum nitride.
2. (Amended) The semiconductor structure of claim 1 and including a metal coating under said dielectric layer; said metal coating comprising a compound of titanium nitride and aluminum.
3. (Amended) The semiconductor structure of claim 2 wherein the dielectric comprises a silicon oxide.
4. The semiconductor structure of claim 3, wherein the metal coating comprises an anti-reflective coating.
5. (Amended) The semiconductor structure of claim 1, wherein the polish stop layer comprises titanium aluminum nitride with between about 5 and 20 percent by weight of aluminum.
7. The semiconductor structure of claim 2, wherein the metal coating comprises about 5 to 20 percent by weight of aluminum.

21. A semiconductor structure comprising:
a metal layer disposed on a substrate;
a layer of titanium aluminum nitride disposed on the metal layer;
a dielectric layer disposed on the layer of titanium aluminum nitride;
a patterned layer of photoresist disposed on the dielectric layer exposing a selected portion of the dielectric layer to an etching process;
wherein the layer of titanium aluminum nitride functions as an etch stop layer upon removal of the selected portion of the dielectric layer to prevent the etching process from compromising the underlying metal layer.